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R. Hugo Patterson

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EXAMINER

STACE, BRENT S

ART UNIT

PAPER NUMBER

2161

DATE MAILED: 09/28/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/611,291

Applicant(s)

PATTERSON, R. HUGO

Examiner

Brent S. Stace

Art Unit

2161

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 20 June 2006.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-51 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-51 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 11 May 2006 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: _____

DETAILED ACTION

Remarks

1. This communication is responsive to the amendment filed June 20th, 2006. Claims 1-51 are pending. In the amendment filed June 20th, 2006, Claims 1, 3, 4, 7, 8, 15, 20, 27, 31, 33, 35, 36, 40, and 47 are amended, and Claims 1, 8, 15, 20, 27, 31, 33, 40, and 47 are independent. The examiner acknowledges that no new matter was introduced and the claims are supported by the specification. This action is FINAL.

Response to Arguments

2. The Applicant's arguments filed June 20th, 2006 with respect to Claims 1-51 have been considered but are not persuasive.
3. With the amendments to the claims, Claims 1-7, 20-26, and 33-39 have substantially changed in scope. As such, a new grounds of rejection may have been applied.
4. As to the applicant's arguments with respect to Claims 1, 20, and 33 for the prior art(s) allegedly not teaching the amended new limitations of the claim, the examiner respectfully disagrees. A new ground of rejection has been applied below that shows how the new claim limitations are taught by Zwilling and Hitz.
5. As to the applicant's arguments with respect to Claims 8, 27, and 40 for the prior art(s) allegedly not teaching "a storage system having a plurality of storage trees having multiple references to the same block of data," the examiner respectfully disagrees.

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Zwilling, col. 12, lines 24-53 with Zwilling, Fig. 2 and Zwilling, cols. 8-9, lines 46-17 were and still are cited in the rejection regarding these limitations. The examiner would like to first point out that the storage trees of Claims 8 and 40 are not limited in the same manner as they are for Claims 27. For instance, the storage trees of Claim 27 are limited to being storage trees each representing a snapshot, while the storage trees of Claims 8 and 40 are not. As such different rejections have been applied. Additionally, Claim 27 does not recite this limitation; therefore, this argument with regard to Claim 27 is invalid. For Claims 8 and 40, Zwilling stores files; therefore, Zwilling is a storage system. Also, the binary tree in Zwilling is multiple storage trees. A tree in its most basic form is one node. Since the citings in Zwilling at least imply multiple nodes in the binary tree, this easily makes multiple storage trees. Multiple references to the same block (page) are the data records in the page with their doubly-linked nature (Zwilling, col. 8, lines 57-59).

6. As to the applicant's arguments with respect to Claims 8, 27, and 40 for the prior art(s) allegedly not teaching "determine active blocks of data within said range, where active blocks of data are those still in one of the plurality of storage trees," the examiner respectfully disagrees. Regarding this argument in relation to Claims 27, Claim 27 does not recite this limitation; therefore, this argument with regard to Claim 27 is invalid.

Zwilling, cols. 8-9, lines 46-17 with Zwilling, col. 5, lines 29-52 with Zwilling, col. 12, lines 24-40 were and still are cited in the rejection regarding this limitation in Claims 8 and 40. Zwilling teaches the finding of active blocks of data (blocks to be moved) within said range (above the fence) in Zwilling, col. 5, lines 29-52 with Zwilling, col. 12, lines 24-40.

Zwilling also teaches in Zwilling, cols. 8-9, lines 46-17 that clustered/log data is represented as a binary tree. Unless the data is removed, the data is always represented in this tree. In this citing Zwilling teaches "where active blocks of data are those still in one of the plurality of storage trees."

7. As to the applicant's arguments with respect to Claims 8, 27, and 40 for the prior art(s) allegedly not teaching "determining, based on accessing in one of said plurality of storage trees, a parent node that has a plurality of descendent nodes, that none of the plurality of descendent nodes are associated with the blocks of data within the range," the examiner respectfully disagrees. Regarding this argument in relation to Claims 27, Claim 27 does not recite this limitation; therefore, this argument with regard to Claim 27 is invalid. Zwilling, col. 5, lines 29-52 with Zwilling, col. 12, lines 24-53 with Zwilling, col. 9, lines 56-65 and Zwilling, cols. 8-9, lines 46-17 (indirectly, via the prune walking) were and still are cited in the rejection regarding this limitation in Claims 8 and 40. Zwilling, cols. 8-9, lines 46-17 teaches that in order to find a page that needs to be moved, (page containing the parent index record for a particular data record) the binary tree is scanned from the root node to the lowest intermediate node before the leaf node containing the data record to be moved pages to be moved are pages that reside above the fence). After all pages have been moved to below the fence, Zwilling, col. 9, lines 56-65 teaches that all the pages above the fence are rescanned. To ensure that none have been reallocated. Only re-scanning the range above the fence, and the required traversal of the binary tree to find pages at least teaches that Zwilling teaches the "determining, based on accessing in one of said plurality of storage trees, a parent node

that has a plurality of descendent nodes, that none of the plurality of descendent nodes are associated with the blocks of data within the range.”

8. In response to applicant's argument that the examiner's conclusion of obviousness is based upon improper hindsight reasoning, it must be recognized that any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning. But so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made, and does not include knowledge gleaned only from the applicant's disclosure, such a reconstruction is proper. See *In re McLaughlin*, 443 F.2d 1392, 170 USPQ 209 (CCPA 1971).

9. As to the applicant's arguments with respect to Claims 15, 31, and 47 for the prior art(s) allegedly not teaching “child nodes of a current node that are within the range to be cleaned,” the examiner respectfully disagrees. Regarding this argument in relation to Claims 31, Claim 31 does not recite this limitation; therefore, this argument with regard to Claim 31 is invalid. Zwilling col. 5, lines 34-52 with Zwilling, Fig. 2 were and still are cited in the rejection regarding this limitation in Claims 15 and 47. In this citing Zwilling teaches that allocation units/nodes from the above the fence (range to be cleaned) are copied to the head of the log (below the fence). An allocation unit/block is associated with a node of a storage tree as seen earlier in the claim, as cited, in Zwilling, col. 10, lines 5-13 with Zwilling col. 8, lines 46-65. This establishes the current node is the lowest intermediate node before the leaf node (child) containing data to be moved.

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10. As to the applicant's arguments with respect to Claims 15, 31, and 47 for the prior art(s) allegedly not teaching "upon determining that a minimum address value among addresses of descendent nodes is within a range to be cleaned," the examiner respectfully disagrees. Regarding this argument in relation to Claims 31, Claim 31 does not recite this limitation; therefore, this argument with regard to Claim 31 is invalid. Zwilling col. 5, lines 29-52 with Zwilling, Fig. 2 were and still are cited in the rejection regarding this limitation in Claims 15 and 47. In the cited section and as can be seen from Fig. 2, Zwilling teaches that the fence address is the cut off address to which all addresses above the fence are moved to below the fence. An allocation unit/block is associated with a node of a storage tree as seen earlier in the claim, as cited, in Zwilling, col. 10, lines 5-13 with Zwilling col. 8, lines 46-65. As cited in Zwilling col. 8, lines 46-65 keys are used to search the tree for the pages needing to be moved. The keys are ordered so that the intermediate index records and data records can be traversed in forward and reverse order from one sibling page to the next or previous. Since this is clustered data, the data is ordered (Zwilling, col. 8, lines 10-15). Obtaining a page to transfer in this method "upon determining that a minimum address value among addresses of descendent nodes is within a range to be cleaned."

11. As to the applicant's arguments with respect to Claims 15, 31, and 47 for the prior art(s) allegedly not teaching "designating, as the current node, one of the child nodes of the current node that is an interior nodes, upon determining that at least one child nodes is an interior node," the examiner respectfully disagrees. Regarding this argument in relation to Claims 31, Claim 31 does not recite this limitation; therefore, this

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argument with regard to Claim 31 is invalid. Zwilling, col. 8, lines 46-65 was and still is cited in the rejection regarding this limitation in Claims 15 and 47. Zwilling, col. 9, lines 15-25 shrinks a file where the file is spread across several pages. These pages are represented as a tree (Zwilling, col. 10, lines 5-13). Therefore, to shrink the file, each node must be designated, at some point, to be a current node, when at least traversing the tree for the node as indicated in Zwilling, col. 8, lines 46-65.

12. As to the applicant's arguments with respect to Claims 15, 31, and 47 for the prior art(s) allegedly not teaching "designating, as the current node, an ancestor node of the current node whose descendent nodes are unprocessed," the examiner respectfully disagrees. Regarding this argument in relation to Claims 31, Claim 31 does not recite this limitation; therefore, this argument with regard to Claim 31 is invalid. Zwilling, col. 8, lines 46-65 was and still is cited in the rejection regarding this limitation in Claims 15 and 47. Since Zwilling, as stated above, searches/traverses the tree for a key, the act of going down the tree (going to an ancestor) will select an ancestor node of the current node whose descendent nodes are unprocessed. As an example, the ancestor of all of the nodes (the root) will be selected as the current node when multiple searches are done on the tree (as can be seen from the multiple pages being moved in Fig. 2).

13. The other claims argued merely because of a dependency on a previously argued claim(s) in the arguments presented to the examiner, filed June 20th, 2006, are moot in view of the examiner's interpretation of the claims and art and are still considered rejected based on their respective rejections from the first Office action (parts of recited again below).

Response to Amendment

Specification

14. The lengthy specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

Claim Objections

15. In light of the applicant's respective arguments or respective amendments, the previous claim objections to the claims have been withdrawn, however new claims objections are warranted by the amended claims as seen below.

16. Claims 1-19, 27-32, and 40-51 are objected to because of the following informalities:

- a. Claim 1 recites poor sentence structure in line 6 where it recites "a plurality nodes." This objection propagates downward through the dependant Claims 2-7. Since Claim 33 is substantially the same as Claim 1 and includes the same objection, Claim 33 is also objected to for the same reason, and this objection propagates downward through the dependant Claims 34-39.
- b. Claim 8 contains typographical errors on lines 4 and 7 with the citing of "including." There should be a colon after "including" indicating a list of

limitations included (as provided with the appropriate claim indentations). These objections propagate downward through the dependant Claims 9-14. Since Claim 40 is substantially the same as Claim 8 and includes the same objections, Claim 40 is also objected to for the same reasons, and these objections propagate downward through the dependant Claims 41-46.

c. Claim 15 recites poor sentence structure in line 2 where it recites "performing following operations until each block of data." This objection propagates downward through the dependant Claims 16-19. Since Claim 47 is substantially the same as Claim 15 and includes the same objection, Claim 47 is also objected to for the same reason, and this objection propagates downward through the dependant Claims 48-51.

d. Claim 15 contains a typographical error on lines 4-5 with the citing of "the operations including." There should be a colon after "the operations including" to indicate a list of limitations included (as provided with the appropriate claim indentations). This objection propagates downward through the dependant Claims 16-19. Since Claim 47 is substantially the same as Claim 15 and includes the same objection, Claim 47 is also objected to for the same reason, and this objection propagates downward through the dependant Claims 48-51.

e. Claim 27 recites poor sentence structure in line 11 where it recites "logic to prune walking of nodes." This objection propagates downward through the dependant Claims 28-30.

f. Claim 31 contains a typographical error on line 2 with the citing of "including." There should be a colon after "including" indicating a list of limitations included (as provided with the appropriate claim indentations). This objection propagates downward through dependant Claim 32.

Appropriate correction is required.

Claim Rejections - 35 USC § 112

17. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

18. Claim 32 is still rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

19. Claim 32 recites "the set of one or more storage trees" when Claim 31 (Claim 32's independent claim) only states "a set of trees." If the set from Claim 32 is one tree, Claim 31's set of trees, would make Claim 31 indefinite. Claim 32 recites the limitation "the set of one or more storage trees " in lines 2-3. There is insufficient antecedent basis for this limitation in the claim.

Claim Rejections - 35 USC § 101

20. 35 U.S.C. 101 reads as follows:

Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

21. Claims 1-19, and 31-51 are rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter.

22. Claims 1-7, 15-19, 33-39 and 47-51 are claims that do not meet the useful, concrete tangible result required for 35 U.S.C. 101. Specifically, Claim 1, 15, 33, and 47 recite no practical application or tangible result. This rejection is not remedied in any dependent claims; therefore, Claims 2-7, 15-19, 34-39, and 48-51 are rejected for the same reason.

23. Claims 8-14 and 40-46 are claims that do not meet the useful, concrete tangible result required for 35 U.S.C. 101. Specifically, Claim 8 and 40 recites no tangible result. This rejection is not remedied in any dependent claims; therefore, Claims 9-14 and 41-46 are rejected for the same reason.

24. Claims 31 and 32 are claims that do not meet the useful, concrete tangible result required for 35 U.S.C. 101. Specifically, Claim 31 appears to be no more than a program per se. This rejection is not remedied in any dependent claim; therefore, Claim 32 is rejected for the same reason.

25. Claims 33-39, 40-46, and 47-51 are claims that do not meet the useful, concrete tangible result required for 35 U.S.C. 101. Specifically, the claims are not limited to tangible embodiments. In view of Applicant's disclosure, specification at page 9, paragraph [0033], the medium is not limited to tangible embodiments, instead being defined as including both tangible embodiments (e.g., disk storage) and intangible embodiments (e.g., carrier waves). As such, the claim is not limited to statutory subject

matter and is therefore non-statutory. This rejection is not remedied in any dependent claims; therefore, Claims 34-39, 41-46, and 48-51 are rejected for the same reason.

26. To expedite a complete examination of the instant application, the Claims rejected under 35 U.S.C. 101 above are further rejected as set forth below in anticipation of applicant amending these Claims to place them within the four statutory categories of invention.

Claim Rejections - 35 USC § 103

27. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

28. Claims 1-7, 18, 20-39, and 50 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 6,249,792 (Zwilling et al.) in view of U.S. Patent No. 5,963,962 (Hitz et al.).

For **Claim 1**, Zwilling teaches: "A method comprising:

- locating blocks of data in a log and within a range at a tail of the log, the range representing an address range within an allocated segment of the log [Zwilling, col. 12, lines 24-53 with Zwilling, Fig. 2] implemented in a hierarchical architecture [Zwilling, cols. 8-9, lines 46-26]

- copying the blocks of data that are referenced and within the range to an unallocated segment of the log” [Zwilling, col. 5, lines 34-52 with Zwilling, col. 12, lines 41-53].

Zwilling discloses the above limitations but does not expressly teach:

- “that are referenced
- having a plurality of storage trees, each representing a snapshot taken at a point in time of target data being processed, each storage tree having a plurality nodes and each node representing a segment of data of a snapshot associated with each storage tree;
- by one or more other blocks of data of other nodes wherein blocks of data that are not referenced by other blocks of data and within the range remain untouched.”

With respect to Claim 1, an analogous art, Hitz, teaches:

- “that are referenced [Hitz, col. 20, lines 25-35]
- having a plurality of storage trees, [Hitz, cols. 17-18, lines 66-16] each representing a snapshot taken at a point in time of target data being processed, [Hitz, col. 17, lines 40-49] each storage tree having a plurality nodes [Hitz, cols. 17-18, lines 66-16] and each node representing a segment of data of a snapshot associated with each storage tree; [Hitz, col. 17, lines 40-49 with Hitz, cols. 17-18, lines 66-16]
- by one or more other blocks of data of other nodes [Hitz, col. 18, lines 35-38] wherein blocks of data that are not referenced by other blocks of data and within

the range remain untouched" [Hitz, col. 15, lines 55-57 with Hitz, col. 16, lines 15-17 with Hitz, col. 20, lines 25-35 with Zwilling, col. 5, lines 29-52 with Zwilling, col. 6, lines 42-49 with Zwilling, col. 12, lines 36-37].

It would have been obvious to one of ordinary skill in the art at the time of invention having the teachings of Hitz and Zwilling before him/her to combine Hitz with Zwilling because both inventions are directed towards conserving file space.

Hitz's invention would have been expected to successfully work well with Zwilling's invention because both inventions use file systems on computers. Zwilling discloses an on-line dynamic file shrink facility comprising shrinking log files. However, Zwilling does not expressly disclose storage trees each representing a snapshot and where unreferenced data remains untouched. Hitz discloses a write anywhere file-system layout comprising storage trees each representing a snapshot and where unreferenced data remains untouched.

It would have been obvious to one of ordinary skill in the art at the time of invention having the teachings of Hitz and Zwilling before him/her to take the write anywhere file-system layout from Hitz and install it into the invention of Zwilling, thereby offering the obvious advantage of taking snapshots of garbage collected data, thus saving space.

Different embodiments of Zwilling are used in the rejection for Claim 27 and its respective dependant claims. Zwilling (as modified by Hitz) teaches all of Claim 27 with assistance from Zwilling's different embodiments.

Claim 2 can be mapped to Zwilling (as modified by Hitz) as follows: "The method of claim 1 comprising designating the range as unallocated" [Zwilling, col. 5, lines 34-52].

Claim 3 can be mapped to Zwilling (as modified by Hitz) as follows: "The method of claim 1, wherein locating the blocks of data that are referenced and within the range includes determining a minimum value among addresses of descendent nodes of a node, [Zwilling, cols. 8-9, lines 46-14] wherein the minimum value represents a minimum address offset of a node that is closest referenced from the blocks of data" [Zwilling, cols. 8-9, lines 46-14 with Zwilling, col. 5, lines 29-52 with Zwilling Fig. 2].

Claim 4 can be mapped to Zwilling (as modified by Hitz) as follows: "The method of claim 3, wherein a location table includes an entry for nodes that reference other nodes [Zwilling, col. 8, lines 46-64 with Zwilling, col. 10, lines 5-13] and wherein determining the minimum value among addresses of descendent nodes of the node includes retrieving the minimum value from an entry in the location table associated with the node" [Zwilling, cols. 8-9, lines 46-14 with Zwilling, col. 10, lines 5-13].

Claim 5 can be mapped to Zwilling (as modified by Hitz) as follows: "The method of claim 4, wherein locating the blocks of data that are referenced and within the range includes processing the descendent nodes of the node upon determining that the minimum value among the addresses of the descent nodes is within the range" [Zwilling, col. 5, lines 29-52].

Claim 6 can be mapped to Zwilling (as modified by Hitz) as follows: "The method of claim 5 comprising modifying the addresses of the copied blocks of data that are stored

in the location table based on the new locations of the copied blocks of data in the log”
[Zwilling, Fig. 3C with Zwilling, col. 8, lines 29-33 with Zwilling, col. 9, lines 4-7].

Claim 7 can be mapped to Zwilling (as modified by Hitz) as follows: “The method of claim 5 further comprising modifying the minimum value in the entry in the table associated with the node when the minimum value changes based on the new locations of the copied blocks of data that are associated with descendent nodes of the node”
[Zwilling, Fig. 3C with Zwilling, col. 8, lines 29-33 with Zwilling, col. 9, lines 4-7 with Zwilling, col. 5, lines 29-52 with Zwilling, col. 10, lines 5-13].

For **Claim 18**, Zwilling teaches: “The method of claim 15.”

Zwilling discloses the above limitation but does not expressly teach: “...wherein at least one block of data stored in the log is referenced by more than one of other blocks of data.”

With respect to Claim 18, an analogous art, Hitz, teaches: “...wherein at least one block of data stored in the log is referenced by more than one of other blocks of data” [Hitz, col. 18, lines 24-30 with Hitz, col. 2, lines 25-36].

It would have been obvious to one of ordinary skill in the art at the time of invention to combine Hitz with Zwilling because both inventions are directed towards storing files on file systems.

Hitz’s invention would have been expected to successfully work well with Zwilling’s invention because both inventions use file systems on computers. Zwilling discloses an on-line dynamic file shrink facility comprising trees/tables for file information/representation, however Zwilling does not expressly disclose the possibility

that the blocks of data could be repeating by what is known in the art as aliases, shortcuts, or symbolic links. Hitz discloses a write anywhere file-system layout comprising file block indirection.

It would have been obvious to one of ordinary skill in the art at the time of invention to take the file block indirection from Hitz and install it into the method of Zwilling, thereby offering the obvious advantage of extending Zwilling's invention to work on files that contain the same data in attempts to save space as the snapshot size increases thereby increasing the number of active snapshots in Hitz.

For **Claim 20**, Zwilling teaches: "A system comprising:

- a storage device to store a number of blocks of data, [Zwilling, col. 5, lines 6-12] wherein the blocks of data that are marked as allocated are non-modifiable, [Zwilling, col. 6, lines 5-10] the blocks of data to be stored as a log; [Zwilling, col. 12, lines 15-17] and
- "a garbage collection logic to locate the blocks of data and within a range at a tail of the log, the range representing and address range within an allocated segment of the log [Zwilling, col. 12, lines 24-53 with Zwilling, Fig. 2] implemented in a hierarchical architecture" [Zwilling, cols. 8-9, lines 46-26].

Zwilling discloses the above limitations but does not expressly teach:

- "that are referenced
- having a plurality of storage trees, each representing a snapshot taken at a point in time of target data being processed, each storage tree having a plurality nodes

and each node representing a segment of data of a snapshot associated with each storage tree.”

With respect to Claim 20, an analogous art, Hitz, teaches:

- “that are referenced [Hitz, col. 20, lines 25-35]
- having a plurality of storage trees, [Hitz, cols. 17-18, lines 66-16] each representing a snapshot taken at a point in time of target data being processed, [Hitz, col. 17, lines 40-49] each storage tree having a plurality nodes [Hitz, cols. 17-18, lines 66-16] and each node representing a segment of data of a snapshot associated with each storage tree” [Hitz, col. 17, lines 40-49 with Hitz, cols. 17-18, lines 66-16].

It would have been obvious to one of ordinary skill in the art at the time of invention having the teachings of Hitz and Zwilling before him/her to combine Hitz with Zwilling because both inventions are directed towards conserving file space.

Hitz's invention would have been expected to successfully work well with Zwilling's invention because both inventions use file systems on computers. Zwilling discloses an on-line dynamic file shrink facility comprising shrinking log files. However, Zwilling does not expressly disclose storage trees each representing a snapshot and where unreferenced data remains untouched. Hitz discloses a write anywhere file-system layout comprising storage trees each representing a snapshot and where unreferenced data remains untouched.

It would have been obvious to one of ordinary skill in the art at the time of invention having the teachings of Hitz and Zwilling before him/her to take the write

anywhere file-system layout from Hitz and install it into the invention of Zwilling, thereby offering the obvious advantage of taking snapshots of garbage collected data, thus saving space.

Different embodiments of Zwilling are use in the rejection for Claim 27 and its respective dependant claims. Zwilling (as modified by Hitz) teaches all of Claim 27 with assistance from Zwilling's different embodiments.

Claim 21 can be mapped to Zwilling (as modified by Hitz) as follows: "The system of claim 20, wherein the garbage collection logic is to copy the blocks of data that are referenced to an unallocated address space of the log" [Zwilling, col. 5, lines 29-52 with Zwilling, Fig. 2].

Claim 22 can be mapped to Zwilling (as modified by Hitz) as follows: "The system of claim 21, wherein the garbage collection logic is to copy the blocks of data that are referenced to a head of the log" [Zwilling, col. 5, lines 29-52 with Zwilling, Fig. 2].

Claim 23 can be mapped to Zwilling (as modified by Hitz) as follows: "The system of claim 20, wherein the garbage collection logic is to mark the range as unallocated" [Zwilling, col. 5, lines 29-52 with Zwilling, Fig. 2].

Claim 24 can be mapped to Zwilling (as modified by Hitz) as follows: "The system of claim 20 wherein at least one of the number of blocks of data are referenced by more than one reference" [Hitz, col. 18, lines 24-30 with Hitz, col. 2, lines 25-36 with Hitz, col. 20, lines 25-35].

Claim 25 can be mapped to Zwilling (as modified by Hitz) as follows: "The system of claim 20 comprising a location table to include entries associated with interior nodes of

a storage tree, [Zwilling, col. 10, lines 5-13] wherein each entry is to include a minimum value among the addresses of descendent nodes of the associated interior node"

[Zwilling, cols. 8-9, lines 46-15 with Zwilling, col. 9, lines 43-51 with Zwilling col. 8, lines 20-35 with Zwilling, col. 7, lines 38-21].

Claim 26 can be mapped to Zwilling (as modified by Hitz) (as modified by) as follows: "The system of claim 25, wherein the garbage collection logic is to locate the blocks of data that are referenced and within the range at the tail of the log based on the minimum values stored in the entries of the location table" [Zwilling, col. 5, lines 29-40 with Zwilling, col. 8, lines 46-65 with Zwilling, col. 10, lines 5-13].

For **Claim 27**, Zwilling teaches:

- "each leaf node of said set of one or more storage trees to include a block of data from said file system [Zwilling, col. 10, lines 5-13 with Zwilling, col. 8, lines 46-65]
- a storage space to store said blocks of data having been allocated in said set of one or more storage devices [Zwilling, col. 5, lines 29-52 with Zwilling, Fig. 2]
- having stored therein a minimum address value of descendent nodes of interior nodes of said set of storage trees; [Zwilling, cols. 8-9, lines 46-15 with Zwilling, col. 9, lines 43-51 with Zwilling col. 8, lines 20-35 with Zwilling, col. 7, lines 38-21] and
- a garbage collection logic to clean a currently selected range from the tail of said log, [Zwilling, col. 5, lines 29-52 with Zwilling, Fig. 2] said garbage collection logic to prune walking of nodes of said set of one or more storage trees based on said

set of location tables and said currently selected range" [Zwilling, cols. 8-9, lines 46-17 with Zwilling, col. 5, lines 29-52 with Zwilling, col. 12, lines 24-40].

Zwilling discloses the above limitations but does not expressly teach: "A backup system comprising:

- a set of one or more storage trees, each representing a snapshot of a file system at a different time...that has been backed up from a set of one or more storage devices
- from a backup storage space
- a set of one or more location tables."

With respect to Claim 27, an analogous art, Hitz, teaches: "A backup system [Hitz, col. 17, lines 40-50] comprising:

- a set of one or more storage trees, each representing a snapshot of a file system at a different time [Hitz, cols. 17-18, lines 50-14] that has been backed up from a set of one or more storage devices [Hitz, cols. 17-18, lines 65-14]
- from a backup storage space [Hitz, cols. 17-18, lines 65-14]
- a set of one or more location tables" [Hitz, cols. 17-18, lines 65-14 with Zwilling, col. 10, lines 5-13].

It would have been obvious to one of ordinary skill in the art at the time of invention to combine Hitz with Zwilling because both inventions are directed towards storing files on file systems.

Hitz's invention would have been expected to successfully work well with Zwilling's invention because both inventions use file systems on computers. Zwilling

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discloses an on-line dynamic file shrink facility comprising a storage tree, location table, and garbage collection, however Zwilling does not expressly disclose multiple trees, or tables as relating to snapshots of storage device(s). Hitz discloses a write anywhere file-system layout comprising storage trees from snapshots of a file system.

It would have been obvious to one of ordinary skill in the art at the time of invention to take the storage device (making 2 storage devices) and the storage trees of snapshots from Hitz and install it into the system of Zwilling, thereby offering the obvious advantage of extending Zwilling's invention to work on archived (snapshot) files in attempts to save space as the snapshot size increases thereby increasing the number of active snapshots in Hitz.

Different embodiments of Zwilling are use in the rejection for Claim 27 and its respective dependant claims. Zwilling (as modified by Hitz) teaches all of Claim 27 with assistance from Zwilling's different embodiments.

Claim 28 can be mapped to Zwilling (as modified by Hitz) as follows: "The backup system of claim 27, wherein two different nodes of a same storage tree reference a same node in the same storage tree" [Hitz, col. 18, lines 24-30 with Hitz, col. 2, lines 25-36].

Claim 29 can be mapped to Zwilling (as modified by Hitz) as follows: "The backup system of claim 27, wherein the garbage collection logic is to update references to a node that is within the currently selected range based on an update to an entry in the set of one or more location tables" [Zwilling, Fig. 3C with Zwilling, col. 8, lines 29-33 with Zwilling, col. 9, lines 4-7].

Claim 30 can be mapped to Zwilling (as modified by Hitz) as follows: "The backup system of claim 27, wherein the garbage collection logic is to prune walking of the nodes of said set of storage trees based on the minimum addresses stored in the set of one or more location tables" [Zwilling, cols. 8-9, lines 46-17 with Zwilling, col. 5, lines 29-52 with Zwilling, col. 12, lines 24-40 with Zwilling, col. 10, lines 5-13].

For **Claim 31**, Zwilling teaches: "An apparatus [Zwilling, cols. 4-5, lines 62-12] comprising:

- "by recording references to blocks of backed up data [Zwilling, cols. 8-9, lines 46-17 with Zwilling, col. 10, lines 5-13]
- an allocator logic to allocate contiguous blocks of storage space from a log of a backup storage space to store said blocks of backed up data [Zwilling, col. 5, lines 29-52 with Zwilling, col. 12, lines 24-40]
- a garbage collection logic to clean a currently selected contiguous range from the tail of said log, [Zwilling, col. 5, lines 29-52, with Zwilling, Fig. 2] said garbage collection logic to,
 - walk only those nodes of said set of storage trees that possibly identify those of said blocks of data that are stored in said currently selected contiguous range or that possibly are themselves stored in said currently selected contiguous range, [Zwilling, cols. 8-9, lines 46-14 with Zwilling, col. 9, lines 43-50] and
 - sweep said currently selected contiguous range" [Zwilling, col. 5, lines 29-52, with Zwilling, Fig. 2].

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Zwilling discloses the above limitations but does not expressly teach:

- “a backup system to backup a file system, said backup file system including,
 - a tracking logic to generate a set of trees each representing backup snapshots of said file system at different times stored in a set of one or more storage devices
 - responsive to deletion of one or more of said backup snapshots.”

With respect to Claim 31, an analogous art, Hitz, teaches: “

- “a backup system [Hitz, col. 17, lines 40-50] to backup a file system, [Hitz, cols. 17-18, lines 65-14] said backup file system including,
 - a tracking logic to generate a set of trees each representing backup snapshots of said file system at different times [Hitz, cols. 17-18, lines 65-14] stored in a set of one or more storage devices [Hitz, cols. 17-18, lines 65-14]
 - responsive to deletion of one or more of said backup snapshots” [Hitz, cols. 17-18, lines 65-14].

It would have been obvious to one of ordinary skill in the art at the time of invention to combine Hitz with Zwilling because both inventions are directed towards storing files on file systems.

Hitz's invention would have been expected to successfully work well with Zwilling's invention because both inventions use file systems on computers. Zwilling discloses an on-line dynamic file shrink facility comprising a storage tree, location table, and garbage collection, however Zwilling does not expressly disclose multiple trees, or

tables as relating to snapshots of storage device(s). Hitz discloses a write anywhere file-system layout comprising storage trees from snapshots of a file system.

It would have been obvious to one of ordinary skill in the art at the time of invention to take the storage device (making 2 storage devices) and the storage trees of snapshots from Hitz and install it into the system of Zwilling, thereby offering the obvious advantage of extending Zwilling's invention to work on archived (snapshot) files in attempts to save space as the snapshot size increases thereby increasing the number of active snapshots in Hitz.

Different embodiments of Zwilling are use in the rejection for Claim 31 and its respective dependant claims. Zwilling (as modified by Hitz) teaches all of Claim 31 with assistance from Zwilling's different embodiments.

Claim 32 can be mapped to Zwilling (as modified by Hitz) as follows: "The apparatus of claim 31, wherein the set of trees include interior nodes and leaf nodes, [Zwilling, col. 8, lines 10-20 with Zwilling, cols. 8-9, lines 46-14] the interior nodes to include references to other nodes in the set of one or more storage trees, [Zwilling, cols. 8-9, lines 46-14] two different interior nodes of a same tree references a same node in the same tree" [Hitz, col. 18, lines 24-30 with Hitz, col. 2, lines 25-36].

Claims 33-39 encompass substantially the same scope of the invention as that of Claims 1-7, respectfully, in addition to a machine-readable medium and some instructions for performing the method steps of Claims 1-7, respectfully. Therefore, Claims 33-39 are rejected for the same reasons as stated above with respect to Claims 1-7, respectfully.

Claim 50 encompasses substantially the same scope of the invention as that of Claim 18, in addition to a machine-readable medium and some instructions for performing the method steps of Claim 18. Therefore, Claim 50 is rejected for the same reasons as stated above with respect to Claim 18.

29. Claims 8-17, 19, 40-49, and 51 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 6,249,792 (Zwilling et al.).

For **Claim 8**, Zwilling teaches: "A method comprising:

- garbage collecting within a range of addresses in a storage system [Zwilling, col. 12, lines 24-53 with Zwilling, Fig. 2] having"

Zwilling discloses the above limitations but does not expressly teach in the same embodiment:

- "a plurality of storage trees having multiple references to the same block of data, the garbage collecting including
- pruning walking of the plurality of storage trees to determine active blocks of data within said range, where active blocks of data are those still in one of the plurality of storage trees, the pruning walking including
 - determining, based on accessing in one of said plurality of storage trees a parent node that has a plurality of descendent nodes, that none of the plurality of descendant nodes are associated with blocks of data within the range; and

- skipping the walking of the plurality of descendent nodes based on said determining.”

With respect to Claim 8, Zwilling teaches in a different embodiment:

- “a plurality of storage trees having multiple references to the same block of data, the garbage collecting including [Zwilling, cols. 8-9, lines 46-17] by
- pruning walking of the plurality of storage trees to determine active blocks of data within said range, where active blocks of data are those still in one of the plurality of storage trees, [Zwilling, cols. 8-9, lines 46-17 with Zwilling, col. 5, lines 29-52 with Zwilling, col. 12, lines 24-40] the pruning walking including
 - determining, based on accessing in one of said plurality of storage trees a parent node that has a plurality of descendent nodes, that none of the plurality of descendant nodes are associated with blocks of data within the range; [Zwilling, col. 5, lines 29-52 with Zwilling, col. 12, lines 24-53 with Zwilling, col. 9, lines 56-65] and
 - skipping the walking of the plurality of descendent nodes based on said determining” [Zwilling col. 5, lines 12-16].

It would have been obvious to one of ordinary skill in the art at the time of invention to combine the different embodiments of Zwilling because the invention is directed towards shrinking files.

Zwilling discloses an on-line dynamic file shrink facility comprising shrinking log files, however Zwilling does not expressly disclose in that same embodiment how it the shrinking is accomplished.

It would have been obvious to one of ordinary skill in the art at the time of invention to take the copying of blocks and file shrinking process from Zwilling and install it into the shrinking log files of Zwilling, thereby offering the obvious advantage of shrinking log files to save space.

Even though Zwilling is only one reference being used to reject Claim 8, the rejection on Claim 8 is under 35 U.S.C. 103(a) because different embodiments of Zwilling are used in the rejection for Claim 8 and its respective dependant claims. Zwilling teaches all of Claim 8 through Zwilling's different embodiments.

Claim 9 can be mapped to Zwilling as follows: "The method of claim 8, wherein the blocks of data are stored in a log and the range is a segment of the log" [Zwilling, col. 12, lines 15-53 with Zwilling, Fig. 2].

Claim 10 can be mapped to Zwilling as follows: "The method of claim 9, wherein the segment is at the tail of the log" [Zwilling col. 5, lines 34-52].

Claim 11 can be mapped to Zwilling as follows: "The method of claim 10, wherein the determining is performed by comparing a minimum offset of the plurality of descendent nodes against the range, [Zwilling, cols. 8-9, lines 46-15 with Zwilling, col. 9, lines 43-51 with Zwilling col. 8, lines 20-35] wherein the minimum offset is accessed when walking the parent node and without walking the plurality of descendent nodes" [Zwilling, cols. 8-9, lines 46-15 with Zwilling, col. 9, lines 43-51 with Zwilling col. 8, lines 20-35 with Zwilling, col. 7, lines 38-21].

Claim 12 can be mapped to Zwilling as follows: "The method of claim 8, wherein the garbage collecting is further performed by:

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- copying the active blocks of data out of the range; [Zwilling col. 5, lines 29-52]
and
- marking the range as unallocated" [Zwilling col. 5, lines 29-52].

Claim 13 can be mapped to Zwilling as follows: "The method of claim 12, wherein the range is a segment at the tail of a log and said copying is from the said segment at the tail to a segment at the head of the log" [Zwilling col. 5, lines 34-52 with Zwilling, Fig. 2].

Claim 14 can be mapped to Zwilling as follows: "The method of claim 12, wherein said copying includes updating addresses of the copied blocks of data within a location table" [Zwilling, Fig. 3C with Zwilling, col. 8, lines 29-33 with Zwilling, col. 9, lines 4-7].

For **Claim 15**, Zwilling teaches: "A method comprising."

Zwilling discloses the above limitation but does not expressly teach in the same embodiment:

- "performing following operations until each block of data that is active in a range to be cleaned at a tail of a log of data is copied to a head of the log, wherein a block of data is associated with a node of a storage tree, the operations including
 - copying blocks of data associated with child nodes of a current node that are within the range to be cleaned to the head of the log;
 - retrieving a block of data associated with the current node, upon determining that a minimum address value among addresses of descendent nodes is within the range to be cleaned;

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- designating, as the current node, one of the child nodes of the current node that is an interior node, upon determining that at least one child node is an interior node; and
- designating, as the current node, an ancestor node of the current node whose descendent nodes are unprocessed.”

With respect to Claim 15, Zwilling teaches in a different embodiment:

- “performing following operations until each block of data that is active in a range to be cleaned at a tail of a log of data is copied to a head of the log, [Zwilling col. 5, lines 34-52 with Zwilling, Fig. 2 with Zwilling, col. 12, lines 15-17] wherein a block of data is associated with a node of a storage tree, [Zwilling, col. 10, lines 5-13 with Zwilling col. 8, lines 46-65] the operations including
 - copying blocks of data associated with child nodes of a current node that are within the range to be cleaned to the head of the log; [Zwilling col. 5, lines 34-52 with Zwilling, Fig. 2]
 - retrieving a block of data associated with the current node, upon determining that a minimum address value among addresses of descendent nodes is within the range to be cleaned; [Zwilling col. 5, lines 29-52 with Zwilling, Fig. 2]
 - designating, as the current node, one of the child nodes of the current node that is an interior node, upon determining that at least one child node is an interior node; [Zwilling, col. 8, lines 46-65] and

- designating, as the current node, an ancestor node of the current node whose descendent nodes are unprocessed” [Zwilling, col. 8, lines 46-65].

It would have been obvious to one of ordinary skill in the art at the time of invention to combine the different embodiments of Zwilling because the invention is directed towards shrinking files.

Zwilling discloses an on-line dynamic file shrink facility comprising shrinking log files, however Zwilling does not expressly disclose in that same embodiment how it the shrinking is accomplished.

It would have been obvious to one of ordinary skill in the art at the time of invention to take the copying of blocks and file shrinking process from Zwilling and install it into the shrinking log files of Zwilling, thereby offering the obvious advantage of shrinking log files to save space.

Even though Zwilling is only one reference being used to reject Claim 15, the rejection on Claim 15 is under 35 U.S.C. 103(a) because different embodiments of Zwilling are use in the rejection for Claim 15 and its respective dependant claims. Zwilling teaches all of Claim 15 through Zwilling's different embodiments.

Claim 16 can be mapped to Zwilling as follows: “The method of claim 15, wherein performing the following until each block of data that is active in the range to be cleaned at the tail of the log of data is copied to a head of the log includes updating addresses of that copied blocks of data within a location table” [Zwilling, col. 8, lines 21-46 with Zwilling, col. 9, lines 5-7].

Claim 17 can be mapped to Zwilling as follows: “The method of claim 15, wherein performing the following until each block of data that is active in the range to be cleaned at the tail of the log of data is copied to the head of the log includes updating a minimum address value among addresses of descendent nodes for an entry for the current node in a location table where the minimum address value changes based on copying of the blocks of data associated with the descendent nodes of the current node” [Zwilling, cols. 8-9, lines 21-15 with Zwilling col. 8, lines 20-35 with Zwilling, col. 7, lines 38-21].

Claim 19 can be mapped to Zwilling as follows: “The method of claim 15 comprising marking the range as unallocated when the blocks of data that are active and within the range are copied to the head of the log” [Zwilling, col. 5, lines 34-52].

Claims 40-46 encompass substantially the same scope of the invention as that of Claims 8-14, respectfully, in addition to a machine-readable medium and some instructions for performing the method steps of Claims 8-14, respectfully. Therefore, Claims 40-46 are rejected for the same reasons as stated above with respect to Claims 8-14, respectfully.

Claims 47-49 and 51 encompass substantially the same scope of the invention as that of Claims 15-17 and 19, respectfully, in addition to a machine-readable medium and some instructions for performing the method steps of Claims 15-17 and 19, respectfully. Therefore, Claims 47-49 and 51 are rejected for the same reasons as stated above with respect to Claims 15-17 and 19, respectfully.

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30. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

Conclusion

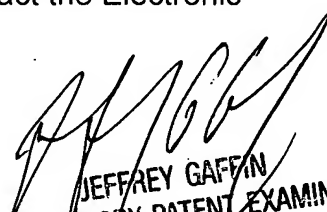
31. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Brent S. Stace whose telephone number is 571-272-8372 and fax number is 571-273-8372. The examiner can normally be reached on M-F 9am-5:30pm EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jeffrey A. Gaffin can be reached on 571-272-4146. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Brent Stace

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